**AP® Calculus AB Syllabus**

**Instructor: Ms. Mary Jude Schmitz**

By successfully completing this course, you will be able to:

* Work with functions represented in a variety of ways and understand the connections among them.
* Understand the many meanings of derivative and use derivatives to solve problems.
* Understand the relationship between the derivative and the definite integral.
* Model a written description of a physical situation with a function, a differential equation, or an integral.
* Use a variety of technology tools to help solve problems, experiment, interpret results, verify conclusions, and practice what you have learned.
* Determine the reasonableness of solutions, including sign, size, relative accuracy, and units of measurement.
* Communicate mathematics by solving problems and with well-written sentences to explain the solution to those problems.
* Develop an appreciation of calculus as a coherent body of knowledge and as a human accomplishment.

**Technology Requirements**

I will use several different technology tools in this class including:

* TI-84 Plus graphing calculator
* The Geometer’s Sketchpad for Macintosh
* Math XL for School
* SMART Notebook and SMART Response
* Class Wiki on wikispaces.com

1. The graphing calculator will be used regularly inside and outside of class to:

* Conduct Explorations
* Graph Functions within arbitrary windows
* Solve equations numerically
* Analyze and interpret results
* Justify and explain results of graphs and equations

1. The Geometer’s Sketchpad will be used on your laptop along with Paul A. Foerster’s Calculus Explorations in order to explore and discover calculus relationships.
2. Math XL for School works with the textbook by Finney, Demana, Waits, and Kennedy (Calculus Graphical, Numerical, Algebraic Media Update) to help practice and get immediate feedback for concepts learned in class.
3. SMART Notebook outlines of each days lessons will be available for download onto your laptop so you can take notes right on your laptop or print out and write notes on the outlines. SMART response questions will be worked into those outlines and SMART response quizzes will be given for homework review.
4. The class wiki will be used for a calendar, homework assignments, discussion questions and review.

**A Brief Description**

Current mathematical education emphasizes a “Rule of Four.” There are a variety of ways to approach and solve problems. The four branches of the problem-solving tree of mathematics are:

* Numerical analysis (where data points are known but not an equation)
* Graphical analysis (where graph is known, but not an equation)
* Analytic/algebraic analysis (traditional equation and variable manipulation)
* Verbal/written methods of representing problems (classic story problems as well as written justification of one’s thinking in solving a problem)

Below is an outline of topics along with a tentative timeline. Assessments are given at the end of each unit as well as intermittently during each unit. Semester finals are also given.

**Unit 1: Functions, Limits and Continuity (4-5 weeks)**

1. Functions and Graphs
2. Functions
3. Domains and Ranges
4. Viewing and Interpreting Graphs
5. Even Functions and Odd Functions
6. Functions Defined in Pieces
7. Absolute Value Functions
8. Composite Functions
9. Exponential Functions
10. Exponential Growth
11. Exponential Decay
12. Applications
13. The number e
14. Functions and Logarithms
15. One-to-One Functions
16. Inverses and Finding Inverses
17. Logarithmic Functions
18. Properties of Logarithms
19. Applications
20. Trigonometric Functions
21. Radian Measure
22. Graphs of Trigonometric Functions
23. Periodicity
24. Even and Odd Trigonometric Functions
25. Transformations of Trigonometric Graphs
26. Inverse Trigonometric Functions
27. Rates of Change and Limits
28. Average and Instantaneous Speed
29. Definition of Limit
30. Properties of Limits
31. One-sided and Two sided Limits
32. Sandwich Theorem
33. Limits Involving Infinity
34. Finite Limits as x approaches infinity
35. Infinite Limits as x approaches a
36. End Behavior Models
37. “Seeing” Limits as x approaches infinity
38. Continuity
39. Continuity at a Point
40. Continuous Functions
41. Algebraic Combinations
42. Composites
43. Intermediate Value Theorem for Continuous Functions
44. Rates of Change and Tangent Lines
45. Average Rates of Change
46. Tangent to a Curve
47. Slope of a Curve
48. Normal to a Curve
49. Speed Revisited

**Unit 2: The Derivative (5-6 weeks)**

1. Derivative of a Function
2. Definition of a Derivative
3. Notation
4. Relationship Between the graphs of *f* and *f*’
5. Graphing the Derivative from Data
6. One-sided Derivatives
7. Differentiability
8. How *f*’(a) Might Fail to Exist
9. Differentiability Implies Local Linearity
10. Derivatives on a Calculator
11. Differentiability Implies Continuity
12. Intermediate Value Theorem for Derivatives
13. Rules for Differentiation
14. Positive Integer Powers, Multiples, Sums and Differences
15. Products and Quotients
16. Negative Integer Powers of x
17. Second and Higher Order Derivatives
18. Velocity and Other Rates of Change
19. Instantaneous Rates of Change
20. Motion along a Line
21. Sensitivity to Change
22. Derivative in Ecomomics
23. Derivatives of Trigonometric Functions
24. Derivative of the Sine Function
25. Derivative of the Cosine Function
26. Simple Harmonic Motion
27. Jerk
28. Derivatives of Other Basic Trigonometric Functions
29. Chain Rule
30. Derivative of a composite Function
31. “Outside-Inside” Rule
32. Repeated Use of the Chain Rule
33. Power Chain Rule
34. Implicit Differentiation
35. Implicitly Defined Functions
36. Lenses, Tangents, and Normal Lines
37. Derivatives of Higher Order
38. Rational Powers of Differentiable Functions
39. Derivatives of Inverse Trigonometric Functions
40. Derivatives of Inverse Functions
41. Derivative of the Arcsine
42. Derivative of the Arctangent
43. Derivative of the Arcsecant
44. Derivatives of the other 3
45. Derivatives of Exponential and Logarithmic Functions
46. Derivative of ex
47. Derivative of ax
48. Derivative of ln x
49. Derivative of logax
50. Power Rule for Arbitrary Real Powers

**Unit 3: Applications of the Derivative (5-6 weeks)**

1. Extreme Value Functions
2. Absolute Extreme Values
3. Local Extreme Values
4. Finding Extreme Values
5. Mean Value Theorem
6. Mean Value Theorem
7. Physical Interpretation
8. Increasing and Decreasing Functions
9. Other Consequences
10. Connecting *f*’ and *f*” with the Graph of *f*
11. First Derivative Test for Local Extrema
12. Concavity
13. Points of Inflection
14. Second Derivative Test for Local Extrema
15. Learning about Functions from Derivatives
16. Modeling and Optimization
17. Examples from Mathematics
18. Examples from Business and Industry
19. Examples from Economics
20. Modeling Discrete Phenomena with different Differentiable Functions
21. Linearization and Newton’s Method
22. Linear Approximation
23. Newton’s Method
24. Differentials
25. Estimating Change with Differentials
26. Absolute, Relative, and Percentage Change
27. Sensitivity to Change
28. Related Rates
29. Related Rate Equations
30. Solution Strategy
31. Simulating Related Motion

**Unit 4: The Definite Integral (4-5 weeks)**

1. Estimating with Finite Sums
2. Distance Traveled
3. Rectangular Approximation Method
4. Volume of a Sphere
5. Cardiac Output
6. Definite Integrals
7. Riemann Sums
8. Terminology and Notation of Integration
9. Definite Integral and Area
10. Constant Functions
11. Integrals on a Calculator
12. Discontinuous Integrable Functions
13. Definite Integrals and Antiderivatives
14. Properties of Definite Integrals
15. Average Value of a Function
16. Mean Value Theorem for Definite Integrals
17. Connecting Differential and Integral Calculus
18. Fundamental Theorem of Calculus
19. Fundamental Theorem Part 1
20. Fundamental Theorem Part 2
21. Area Connection
22. Analyzing Antiderivatives Graphically
23. Trapezoidal Rule
24. Trapezoidal Approximations
25. Other Algorithms
26. Error Analysis

**Unit 5: Differential Equations and Mathematical Modeling (4 weeks)**

1. Slope Fields
2. Differential Equations
3. Slope Fields
4. Antidifferentiation by Substitution
5. Indefinite Integrals
6. Leibniz Notation and Antiderivatives
7. Substitution in Indefinite Integrals
8. Substitution in Definite Integrals
9. Antidifferentiation by Parts
10. Product Rule in Integral Form
11. Solving for the Unknown Integral
12. Tabular Integration
13. Inverse Trigonometric and Logarithmic Functions
14. Exponential Growth and Decay
15. Separable Differential Equations
16. Law of Exponential Change
17. Continuously Compounded Interest
18. Radioactivity
19. Modeling Growth with Other Bases
20. Newton’s Law of Cooling
21. Logistic Growth
22. How Populations Grow
23. Partial Fractions
24. The Logistic Differential Equation
25. Logistic Growth Models

**Unit 6: Applications of Definite Integrals (4 weeks)**

1. Integral as a Net Change
2. Linear Motion Revisited
3. General Strategy
4. Consumption Over Time
5. Net Change from Data
6. Work
7. Areas in a Plane
8. Area Between Curves
9. Area Enclosed by Intersecting Curves
10. Boundaries with Changing Functions
11. Integrating with Respect to y
12. Saving Time with Geometry Formulas
13. Volumes
14. Volume as an Integral
15. Square Cross Sections
16. Circular Cross Sections
17. Cylindrical Shells
18. Other Cross Sections
19. Applications from Science and Statistics
20. Work Revisited
21. Fluid Force and Fluid Pressure
22. Normal Probabilities

**Unit 7: Review/Test Preparation (5-6 weeks)**

1. Multiple-choice practice (review problems from supplemental materials with the textbook and other review books I have purchased.)
2. Test taking strategies are emphasized
3. Individual and group practice both used
4. Student Response System (clickers) used for immediate feedback
5. Free-Response practice
6. Rubrics are reviewed so students see the need for complete answers
7. Students collaborate to formulate team responses (games and other methods used)
8. Individually written responses are crafted. Attention to full explanations is emphasized.

**Unit 8: After the Exam…**

1. Projects designed to incorporate this year’s learning in applied ways

**Textbook and other Supplemental Materials**

Finney, Demana, Waits, and Kennedy. *Calculus-Graphical, Numerical, Algebraic.* Third Edition Media Update. Pearson Prentice Hall, 2010

Paul A. Foerster. *Calculus Exporations.* Key Curriculum Press 1998

Mark Howell and Martha Montgomery. *Be Prepared for the AP® Calculus Exam*. Skylight Publishing 2005

My hope for this class is that you will learn through explorations how to discover calculus concepts for yourself and apply these to several different areas of our world. Hopefully, through calculus you will understand the universe a little better and be able to predict or explain much of what goes on around you. Math is much more than numbers and algorithms and it is my goal, through this class, that you will have a much better appreciation for math than when we started.